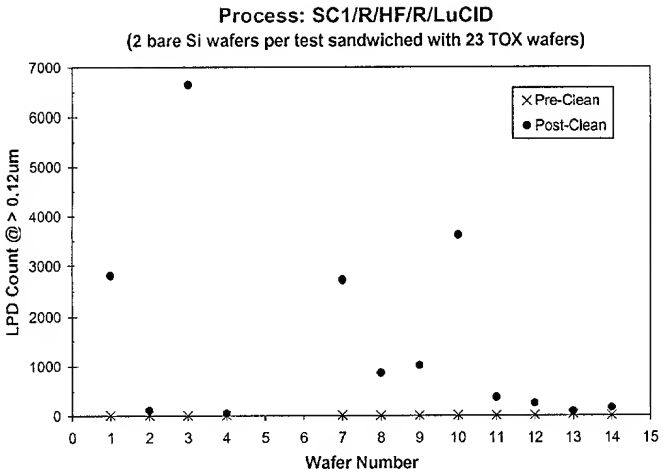

Fig. 1 (comparative)

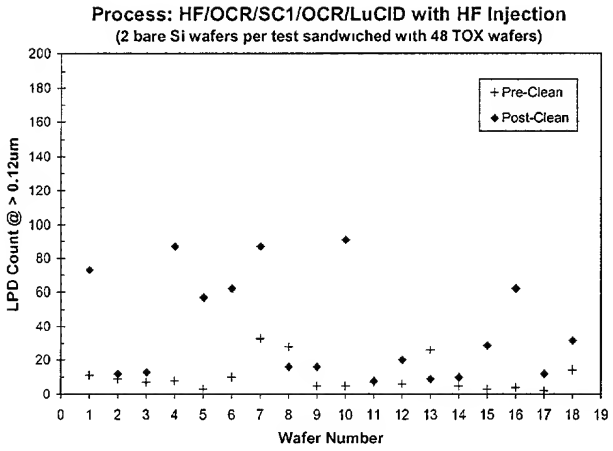

FIG. 2 (Invention)

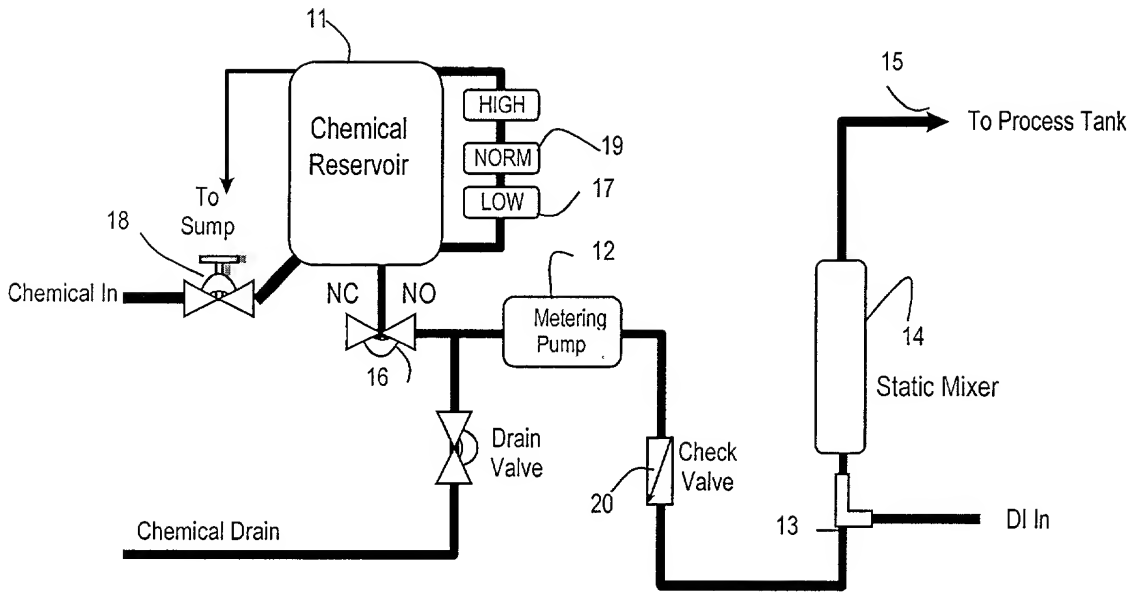

FIG. 3 (Invention)

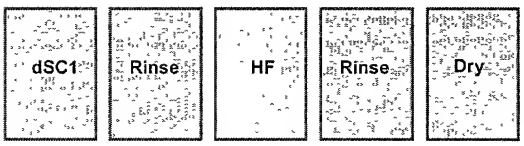

FIG. 4 (comparative)

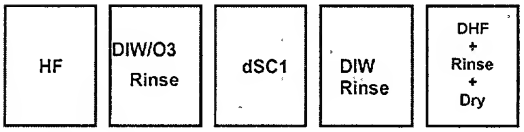

FIG. 5 (Invention)

- Fully Automated GAMA (50x200 mm)
- LuCid dryer w/ HF controlled injection
- 3 mm EE (Omega composite carrier)
- KLA-Tencor Surfscan calibrated at 0.12 µm
- Low count Si wafers were placed between oxide dummy wafers
- HF ~ 100:1 @ ambient temp.
- DHF ~ 400:1 @ ambient temp.
- dSC1 ~ 1:2:50 @ 50 C and 800 W
- DIO3 rinse ~ 5 ppm at ambient temp.
- DO_2 was controlled < 1 ppb
- ASML Reactor

FIG. 6 (Invention)

Cleaning Recipe	48 Filler Wafs	LPD Sum @ > 0.12um			Rudolph post-cln oxide (A)	Rudolph post-cln 1 Sigma	Post-Epi LPD >0.12um
		Pre-Clean	Post-Clean	Delta			
SC1/OCR/HF(+surft)/OCR/LuCID(inj HF+R+Dry)	TOX	3	16	13	4.390	0.256	66
	TOX	15	27	12	4.275	0.188	379
	TOX	8	45	37	4.201	0.234	211
SC1/OCR/LuCID(HF+R+Dry)	TOX	9	73	64	4.728	0.414	329
	TOX	10	12	2	4.553	0.294	267
OCR/LuCID(HF+R+Dry)	TOX	4	30	26	4.805	0 133	377
	TOX	8	40	32	4.7	0.117	250
HF/OCR/SC1/OCR/LuCID(inj HF+R+Dry)	TOX	8	87	79	4.51	0.191	241
	TOX	3	57	54	4 459	0.107	125
	TOX	10	62	52	4.362	0.142	185
HF/OCR/SC1/OCR/LuCID(stg HF+R+Dry)	TOX	33	87	54	4.351	0.095	243
	TOX	28	16	-12	4.37	0.124	524
	poly & ntrd	5	16	11	4.389	0.095	227
	poly & ntrd	5	91	86	4.341	0.129	430
	poly & ntrd	6	20	14	4.334	0.112	158
	poly & ntrd	26	9	-17	4.288	0.087	141
	poly & ntrd	5	10	5	4.258	0.134	257
	TOX	3	29	26	4.584	0.18	242
	TOX	4	62	58	4.501	0.231	335
	TOX	2	12	10	4.252	0.113	207
	TOX	14	32	18	4 325	0 126	322

FIG. 7 (Invention)

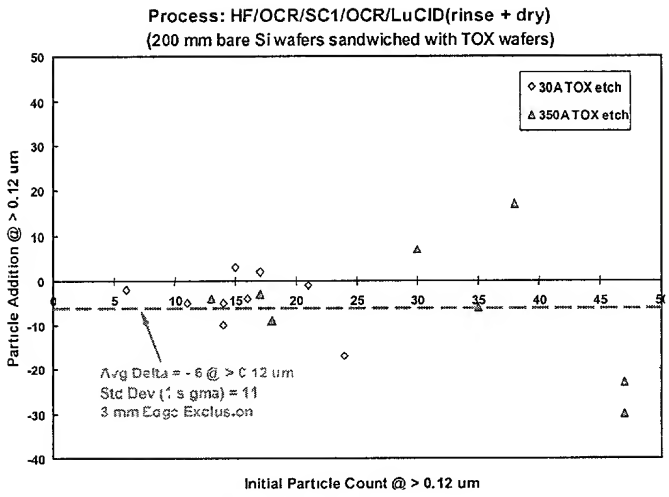

FIG. 8 (Control)

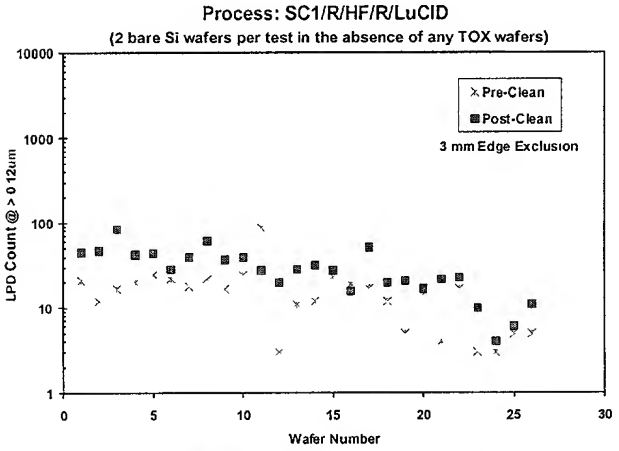

FIG. 9 (Prior art)

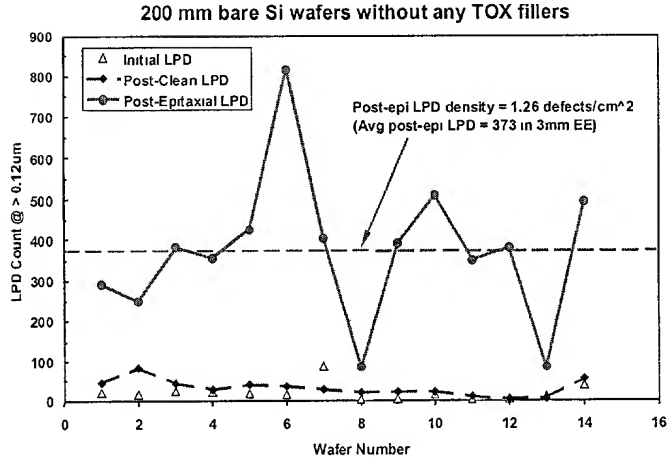

FIG. 10 (Invention)

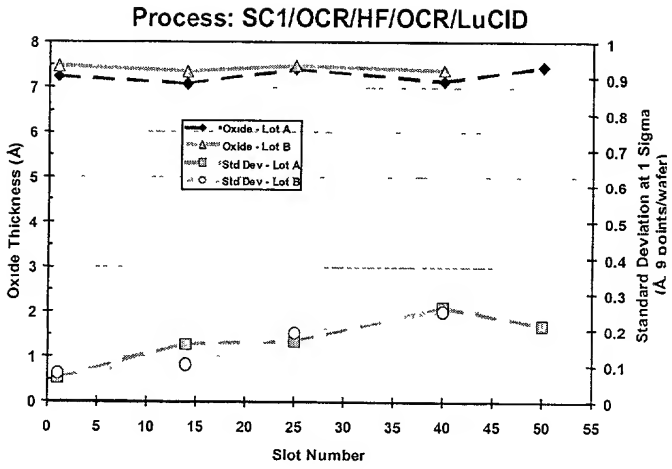

FIG. 14

(After Step B of Invention)

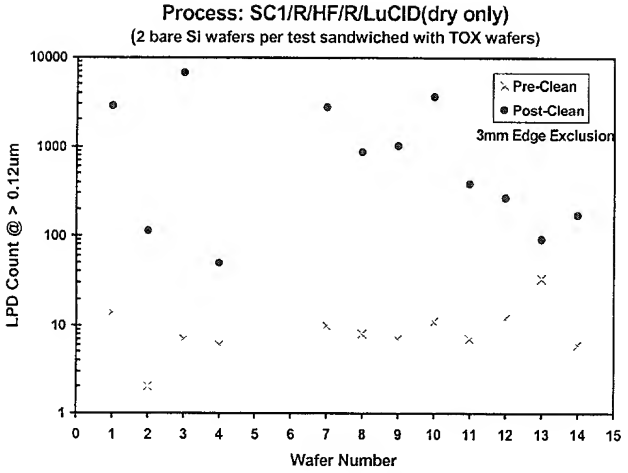

FIG. 11 (Comparative)

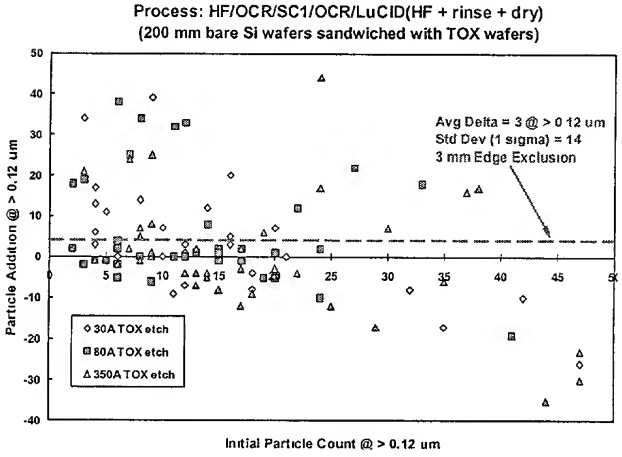

FIG. 12 (Comparative)

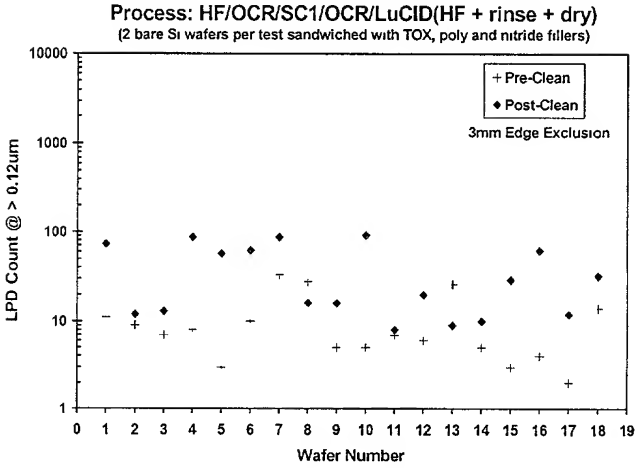

FIG. 13 (Invention)

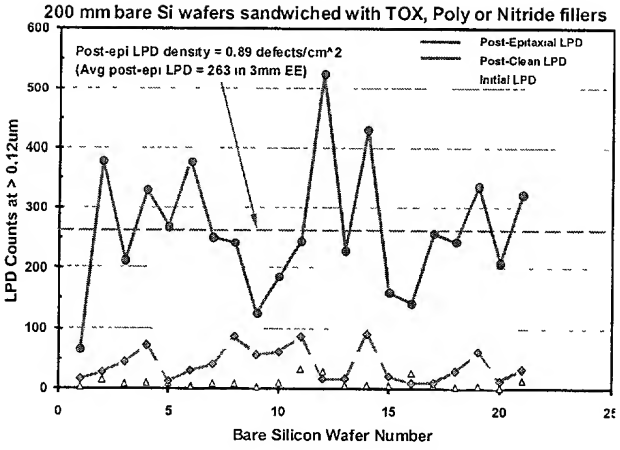

FIG. 15 (Invention)

InSitu Etch Rate and Uniformity of Thin Oxides- Sample Data 1

Process 3: **ER and Etch Uniformity in LuCID with HF injection (5 TOX wafers / 2BareSi+43TOX)**

Thickness	1	2	3	4	5	6	7	8	9	Avg	1σ (A)
before	1011.5	1000.1	996.62	1014.1	1027.3	1014.7	1025.5	1040.6	1034.8		
after	982.70	969.38	965.08	984.33	1000.8	987.71	1000.6	1016.2	1009.7		
(wfr B1) Δ	28.8	30.72	31.54	29.77	26.5	26.99	24.9	24.4	25.1	27.64	2.6
before	1024.5	1015.4	1014.2	1020.8	1032.7	987.21	1028.7	1044.5	1033.6		
after	997.28	987.61	985.70	991.46	1007.5	963.79	1004.7	1019.8	1008.4		
(wfr B13) Δ	27.22	27.79	28.5	29.34	25.2	23.42	24.0	24.7	25.2	26.15	2.1
before	2884.5	2884.2	2858.2	2873.0	2900.3	2870.0	2859.9	2857.3	2892.7		
after	2858.0	2858.1	2832.1	2847.9	2875.5	2844.2	2837.3	2833.1	2863.6		
(wfr B25) Δ	26.5	26.1	26.1	25.1	24.8	25.8	22.6	24.2	29.1	25.59	1.8
before	994.56	996.43	979.71	1010.3	1021.3	967.93	998.54	1033.9	1010.3		
after	964.18	970.49	953.16	982.78	996.10	943.82	967.09	1008.1	980.19		
(wfr F13) Δ	30.38	25.94	26.55	27.52	25.2	24.11	31.45	25.8	30.11	27.45	2.6
before	1013.2	1013.2	1003.1	1028.9	1018.5	961.08	1017.6	1035.5	1013.3		
after	987.39	988.36	975.99	1000.5	990.61	930.87	987.88	1009.1	984.69		
(wfr F25) Δ	25.81	24.84	27.11	28.4	27.89	30.21	29.72	26.4	28.61	27.66	1.8

FIG. 16 (Invention)

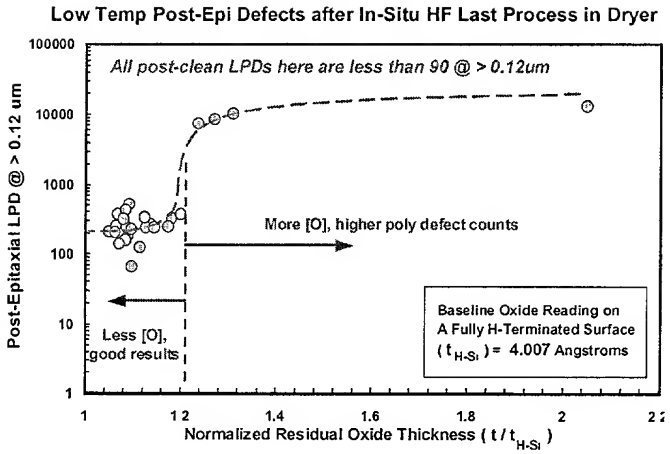

FIG. 17 (Invention)